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Severe convective storms in the European societal context

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ABSTRACT

Basic issues associated with how a forecast becomes effective in helping users make decisions based on weather information are described, with a special emphasis on how this might develop in Europe. The notion of a chain of events that begins when the forecast is issued and ends with the user taking effective actions is used to point out what needs to be done to make the process work properly. Geophysical hazard risks and how people respond to the risks associated with them are discussed, concluding that complacency is a major challenge to helping people make appropriate decisions when severe convective storms threaten them. The situation in Europe regarding the threat of severe convective storms is reviewed and some conclusions are drawn. The key conclusion is that there must be a substantial effort to convince Europeans that they are not immune to severe convective weather hazards, since without public support, the weather community in Europe can do little to mitigate the threats posed by severe convective storms.

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1. Introduction

Meteorologists generally are educated and trained to use scientific tools and concepts for the purpose of research and forecasting the weather. They are not educated and trained in the methods associated with the social sciences and hence generally are not qualified to analyze and diagnose issues tied to the social sciences. Therefore, an important challenge to meteorologists is to understand how their forecasts might be perceived by the general public, because this is critical for knowing how best to create *effective* forecast products.

Of course, the purely meteorological challenge of producing highly accurate forecasts of severe convective weather is a difficult one in its own right, and surely deserves attention. There are two broad classes of forecast problems: the first is that group of forecasts for which the forecaster is unaware of, or unable to apply properly, existing understanding of atmospheric science to the forecast. Presumably, forecaster

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education and training can lead to improved forecasts for this first group. The second is that group of forecasts for which existing meteorological understanding is inadequate. This type of problem is a source for research, which may or may not be able to provide help for this challenge.

No matter how accurate the forecasts become, however, there is a chain of conditions that control how effective those forecasts might be in providing useful information to the forecast users. Any gap in this chain will render the forecasts completely ineffective, no matter how accurate those forecasts might be.

For severe convective storm forecasts to become effective, moreover, the challenge goes beyond the effort to communicate information. A substantial infrastructure must be in place prior to the issuance of those weather predictions. In the United States of America (USA), the infrastructure for dealing with severe convection developed in response to a growing public awareness of the importance of severe convective weather. There was no orderly, systematic process by which the necessary infrastructure was created — in fact, the process was basically done in an ad hoc fashion (Galway, 1989; Doswell et al., 1999). At first, no one knew how to do this, and so choices were made that subsequently became entrenched as a foundation on which new ad hoc decisions were made and implemented. There was never a careful, comprehensive study of how to convey information about, and respond to, the threat of severe convective weather in an optimal way.

Europe is in a unique position to create this infrastructure, as public sector severe convective storm forecasting is in its infancy in Europe; there is only limited existing structure upon which to build (Ruahala and Schultz, 2009). This is both a challenge and an opportunity — the challenge is to create a system that is closely matched to the European social context, and the opportunity is tied to the absence of much existing infrastructure to compete with new ideas of how best to serve the users of such forecasts.

In Section 2, the infrastructure requirements will be reviewed, followed in Section 3 by a review of how geophysical hazards lead to the potential for disastrous severe convective weather events. Section 4 reviews the existing situation in Europe and European societal perceptions, and Section 5 provides some concluding discussion.

2. The chain of conditions

Suppose that forecasts of severe convective weather have been created by someone and they are ready to be disseminated. What is needed for those forecasts to serve best the users of that weather information? The value of a forecast is not exclusively tied to its accuracy — see Murphy and Ehrendorfer (1987) for an extended discussion of the connection between forecast accuracy and forecast value. Value is always directly related to the needs of the users, whereas accuracy is mostly a meteorological topic. Given the existence of a forecast product in some weather forecasting office, the following must happen before the user is able to use that information effectively.

2.1. The forecast user must receive the information

For the information to be of any use at all, it must somehow be transmitted to those likely to be affected. For 24-h forecasts and longer, these can be disseminated at fixed times and would be for relatively large areas. This corresponds to the "outlooks" issued in the USA by the Storm Prediction Center (see http://www.spc.noaa.gov/misc/aboutus.html) of the National Weather Service. Presumably, if such forecasts are available, they can be spread widely by means of various media, as well as directly by the issuing office to specific forecast users (e.g., emergency managers). Convective storm forecasts on this scale could be included in routine weather forecast dissemination whenever the severe weather threat exceeds some threshold risk level.

Forecasts on time scales shorter than 24-h should not be issued at fixed times, but only when the threat level (again, some sort of threshold would have to be exceeded) is high enough to warrant notifying forecast users of the increasing threat. This includes both the so-called "watches" and "warnings" issued in the USA. Watches are for regions where the threat has increased and storms are either about to commence or have already begun. The warnings are for relatively small areas in the path of existing storms, either known to be producing severe weather or seem likely to produce severe weather as deduced from radar. Dissemination of this highly perishable, critical weather information must be done quickly and efficiently.

2.2. The forecast user must understand the information

Once the information has been received, the forecast user must understand what the forecast means. Although the meaning may seem obvious to a meteorologist, it may not be at all clear to the user. That understanding needs to include awareness of the inevitable *uncertainty* in the forecast information. It should not be necessary for the user to have to guess about the uncertainty associated with the forecast. Rather, uncertainly information should always be included.

2.3. The forecast user must know what to do with the information

This presumes, of course, that the user can actually do something to mitigate the hazard posed by potentially severe storms. A farmer can't do anything about a hailstorm threatening crops, but if that same hailstorm threatens a city, people can move their vehicles to a place of shelter and thereby prevent hail damage. A big concern is always for human casualties, and so users must be aware of what they can do to avoid becoming casualties, and also should know what not to do. This sort of knowledge cannot be conveyed effectively during the relatively short times available during an actual severe weather situation. What is necessary is a public education campaign long before severe convective storms become a potential hazard. There should be severe weather awareness exercises held every year and people should develop (and revise, if necessary) action plans and participate in drills practicing those plans at least once a year, if not more frequently.

2.4. The forecast user must believe the information

To some extent, this condition depends on the overall accuracy of the forecasts. There certainly is a tendency for false alarms to de-sensitize the forecast users, although this can be mitigated by including uncertainty information in the forecasts. But it also depends on other factors. What is the perceived expertise level of the person issuing/broadcasting the forecast